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ABSTRACT

Prepared for a 1984 Organisation for Economic Cooperation and Development (OECD) conference, this report analyzes trends and changes in elementary, secondary, higher, and distance education curricula and institutional structures on the basis of a number of case studies from Australia, Belgium, Canada, Denmark, Japan, New Zealand, the Netherlands, Turkey, the United Kingdom, and the United States. Divided into four sections by level or type of education, the report reviews changes in curricula, including the most frequently reported use of new information technology and related activities; changes in the teaching/learning environment, including user populations and teacher, parent, and student attitudes; and changes in institutional structures, including implementation policy, financial allocations, and policy changes in regard to administrative staff and physical resource allocation. A final chapter summarizes trends and issues across all educational levels and types. (MBR)

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International Conference on Education and New Information Technologies

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CHANGES IN CURRICULA AND INSTITUTIONAL STRUCTURES

1. The attached document has been prepared by Peter Bollerslev, Head Teacher, Taastrup, Denmark, and Nolan Estes, Professor, University of Texas at Austin, United States, in their capacity as consultants to the Secretariat. It will serve as one of the background reports for Working Groups 2, 3 and 4.

2. The views expressed are those of the authors and do not commit either the Organisation or the national authorities concerned.

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INTRODUCTION

1. As foreseen in many of the national reviews analysed in the report CERI/NT/84.02 the introduction and use of new technologies in education has already caused or is expected to cause changes in curricula and institutional structures. This synthesis report analyses the trends concerning changes in curricula and institutional structures on the basis of a number of case studies from Australia, Belgium, Canada, Denmark, Japan, New Zealand, the Netherlands, Turkey, United Kingdom and United States. The case studies were carried out in 1983, most of them in late 83. The very extensive USA-study was based on a questionnaire developed at University of Austin, Texas. The other case studies were based on a questionnaire drawn up on the basis of the USA-model, but not going into as many details.

2. The report is divided into four main parts. The first chapter deals with primary and lower secondary education, the second chapter looks at upper secondary education, the third chapter is on further and higher education and chapter four deals with distance education at various levels. The trends found in each part are based on rather few case studies. As the countries differ very much due to geography, educational systems, political circumstances etc., it is not easy to learn from experience in another country. Therefore no comparisons are made between countries.

3. In the report there are many quotations from the case study reports, as these statements express "hands-on-experience" about the trends.

Chapter I

Primary and Lower Secondary Education

A. Changes in Curricula

4. Generally, the elementary and middle school curricula have been impacted by the new information technologies by the incorporation of two new technology-related facets: (1) teaching with computers (computer-assisted instruction), and (2) teaching about computers (computer literacy, computer science, programming). The international case studies report wide variations in the extent to which elementary and middle schools use technology for these purposes, as well as in the level of student and subject matter targeted. Many of the schools and school districts are in the initial phases of planning or implementing the use of technology for instructional purposes. Nevertheless, some generalisations are possible.

5. The most frequently reported use of technology at the elementary level is for computer-assisted instruction in reading and mathematics. Generally, this takes the forms of drill and practice exercises, enrichment activities, and remedial activities.

-- In the United States, very minimal use of technology is reported for problem solving, simulations, or the development of reasoning skills.

-- In the Denmark study, a focus is placed on problem-solving, which has been found to have a great pedagogical effect in terms of transfer to other subject areas.

-- In the United Kingdom study, the computer has provided the students a method for handling primary source data, which would not otherwise have been possible.

-- The Australian study illustrates the successful application of computer-assisted instruction to the area of handwriting. The procedure for teaching handwriting skills has been radically changed as a result of the introduction of the technological approach. Since the technology is used to present exercises, teachers have

spent a greater proportion of the time in reviewing curriculum materials and deciding which materials suit individual students. In essence, the repetitive aspects involved in the traditional forms of teaching handwriting have been replaced by a computer presentation which offers significant advantages. It was found that changes in curriculum had taken place because teachers have started to use the technology as a classroom research tool in that they have begun to experiment with varying curriculum materials for different students. Thus, the technology has given teachers a powerful tool with which to plan appropriate curriculum strategies.

6. Teaching about computers is generally introduced at the upper elementary or middle school level.

-- Some of the districts in the United States study defined "computer literacy" through the development of a list of objectives or skills that students are expected to master at a given level. In some cases, these objectives define a new "strand" of the curriculum parallel in structure to a language arts or mathematics strand. In other cases, the objectives are added to an existing strand, such as that of mathematics or science, but no real integration has been reported.

-- The Council of the Great City Schools (Attachment D to the USA study) reports that many large districts do not have a computer literacy course, per se, but rather infuse literacy throughout the curriculum as part of their computer-assisted instruction plan.

-- The Denmark study describes a mandated subject for grades 5 to 9 in which the students are taught about the positive and negative societal implications of the new technology as well as programming and information about the hardware.

7. Overall, the new information technologies have had only a moderate impact on the elementary and middle school curricula. Most elementary curricula have remained unchanged, with teachers using the computer as another teaching tool to support or supplement the regular program of instruction. Computer literacy courses may be introduced at the middle school level, but not in any interdisciplinary fashion. It is too early to be certain as to how the introduction of new technology is affecting the curriculum. From the experience to date we are just able to draw indications as to possible future developments. Some of the teachers questioned whether anything new was being done with the computer that had not been done before albeit in other ways.

The introduction produces side effects as the high level of motivation and skills developed using the computer are transferred to other activities.

-- The United Kingdom study and the US Congress, Office of Technology Assessment Report, both cite the lack of good software as a major limitation in the application of technology to education. This shortage of software can lead to an undesirable effect on the curriculum, namely it can distort it: activities are undertaken that fit the availability of particular software rather than meeting needs.

-- The report by the Council of the Great City Schools (USA) points out the difficulty in altering elementary curriculum because of the need for more broadly based curriculum revision at that level.

-- The Denmark study states that no formal changes were made in the curriculum that the new computer "informatics" course lessons were simply added to the normal timetable. However it was found that the experiences from this new area influenced the teaching of other subjects. The new subject could be characterised as having interdisciplinary qualities.

B. Changes in the Teaching/Learning Environment

8. The use of new information technologies has definitely increased individualisation of instruction, but only for special populations of students, particularly students who are handicapped in some way.

-- The Australian handwriting program was originally developed for mildly intellectually handicapped pupils. Equipment to suit the given learning task was devised and adapted. The educational objectives were not compromised to suit readily available equipment.

-- The United States study reports that the students most involved with computers are those who are either high- or low-achievers, due to (1) pre-packaged software being geared toward either drill and practice/remediation (for low-achievers) or enrichment activities (for high-achievers), and (2) government resources being most available for students of special populations.

-- The Commission of the European Communities reports the use of computers for teaching a wide range of handicapped students, from those with cerebral palsy, autism, or severe motor impairment to those who are blind, deaf, or non-lingual.

9. Only a few school districts report the use of computer-managed instruction, that is, using computers to record students' progress through the instructional program.

-- One of the Dutch case studies describes a primary school for foreign students in which the computer is used for testing and assignment purposes.

-- A large district in the United States study reports a similar district-wide use of computer-managed instruction.

10. Because of the restricted scope of the international case studies, it is difficult to estimate the actual numbers of students and teachers who utilise computers on an ongoing basis. However, the limited evidence available indicates that these numbers at the elementary level are relatively small.

-- The United States report estimates that the number of students and teachers involved in some computer-related instruction ranges from as little as 2 per cent to as much as 100 per cent in a given district. The average seems to be about 10 to 25 per cent of the students involved at the present time, which includes both elementary and secondary education.

-- A survey conducted by the US Council of the Great City Schools indicates a ratio of one computer for every 863 elementary (K-6) students.

-- While the United Kingdom Government schemes have been highly successful in encouraging schools to acquire micro-computers, the volume of hardware purchased is still a long way from that which would enable significant change to take place in the provision of learning opportunities. A recent survey from the DES and Schools Broadcasting Council indicates that every secondary school and a third of all primary schools now have a micro-computer but this still means that there is only one micro-computer for every 200 pupils.

-- In Denmark approximately 20 per cent of the primary schools (February 1984) are equipped with micro-computers. There is a ratio of one computer for every 125 pupils.

11. New information technology seems to generally have a high impact on the attitude of students, teachers, and parents. The changes that occur in curricula and the implications for the teaching/learning environment are closely linked to the way in which the technology is being used. The computer-based presentation has obvious advantages over conventional procedures. It should be made clear to teachers that a program's effectiveness is related very strongly to the way in which they use it. In this way, teachers concerned will not consider the computer as a threat to their profession but as a powerful teaching tool which they can utilise.

-- The Australian study emphasizes the strong increase in motivation and attention span of normally distractible students when using the computer. Similarly, this study reports high enthusiasm from the teachers who view the computer as a very powerful teaching tool.

Within the teachers, the women showed a change in attitude. Their initial attitude to the role of computers in education could be described as that of scepticism, but at the end of the field trials, all teachers were positive and enthusiastic. Their previous attitude to the role of technology in education was based on their perception of computers as being for mathematics and "shoot-or-be-shot" games, both male dominated areas. The use of computer-based handwriting instruction was their first introduction to areas of curricula which they perceived as being within the domain of women.

-- The United Kingdom study indicates that interest in computers is shared by both sexes across a multi-ethnic clientele. The findings show that some parts of the curriculum appeal more to boys than girls and vice versa, and that boys would find it more interesting to use computers than girls do. But it was also found that at this age level both boys and girls appeared to be making equal use of technology and developing the same new skills in this extension of the curriculum: "computer awareness" or "information skills". However this study also cautions against pushing technology too hard or too fast because of the negative impact that might have on teacher attitudes.

-- Districts interviewed in the United States study reported strong pressure from parents to institute computer programs. Unfortunately, this is not accompanied by much in the way of home-based computer learning.

-- In the United Kingdom study, the gains achieved by certain children using the computer were well above the teachers' expectations of what they would achieve. In fact, the teachers most involved with the computer indicated that it would be used to encourage children to be more independent and take greater responsibility for their own work.

C. Changes in Institutional Structures

12. Because the United States study covers 25 case studies, as opposed to one or two from each of the other countries, the changes in the institutional structures noted in the United States study will be conveyed here in extenso. Many of these apply to the international scene as well. These changes are manifested in the form of policies being followed by the various districts.

13. Indications of policy changes related to technology are apparent in all the respondent districts. Some governing boards have stated explicit policies, others have indicated implicit policies through certain actions or programmes, while others are at the investigative stage of policy-making. The observed policy changes have affected five areas: (1) the instructional programme, (2) financial allocations, (3) administrative staffing, (4) physical facilities, and (5) communications.

14. Policies regarding the implementation of technology in the instructional programme fall into two types: those that focus on the student and those that focus on the teacher. Some districts have addressed their policies to the curriculum and what each student is expected to learn. Others have focused their policies on teacher training and what new competencies teachers should demonstrate. A few districts have developed plans which have integrated both these components. Many governing boards are considering or have already instituted new requirements for graduation which include a demonstration of computer literacy. The extent to which "computer literacy" is explicitly defined varies greatly from district to district. A few districts have mandated teachers to take some computer training which is arranged by the district. Some districts will not approve a school's purchase of hardware until an appropriate number of teachers have been trained. One respondent district requires that all the teachers pass a certification test to indicate knowledge of computers.

15. Policy changes are most evident in the area of financial allocations. The implementation of technology is expensive, and districts have utilised a wide variety of strategies to meet the costs of this endeavour. A critical point which must be noted is that even in districts which are reducing staff as a budget measure, resources are being found to purchase computer hardware and software.

i) Many districts are directing state and federal funds, particularly those targeted for special populations, to the purchase of computers.

ii) Some districts are utilising state textbook money for the technology effort.

iii) Some districts are redirecting funds allocated for library books, media equipment, and basic supplies to the purchase of computer equipment.

iv) Parent-teacher organisations are helping some districts to purchase computers.

v) An increasing amount of resources is being provided by the private sector. Technological businesses in particular have been providing school districts with expertise, equipment, and financial assistance for technology. One district's governing board has a policy to match funds given by any outside source for technology. Other districts are working in conjunction with computer companies for the development of software to meet the district's needs. Several computer companies offer teacher training as part of a computer purchase.

vi) Some governing boards have added the costs of the technology effort to the regular budget of the district.

16. Nearly all districts have addressed the need to designate administrative staff to co-ordinate the technology effort in the district.

i) Most districts have hired at least one and usually more new central office administrators to plan and co-ordinate the implementation of technology in the instructional and/or management area of the system.

ii) Two large respondent districts have established a Department of Technology. The functions of such a department may include centralised procurement of hardware and software, evaluation of hardware and software, maintenance, teacher training, and implementation assistance to individual schools.

iii) Some districts prefer to utilise all levels of staff in the planning and implementation efforts, rather than to designate specialists for one role.

iv) Some small districts have added new technology-related responsibilities to the assignments of existing staff members, rather than hiring new staff.

17. All respondent districts reported policy changes with regard to the provision and utilisation of physical resources.

i) Many districts have established or plan to establish a computer laboratory in each school building. Often space is made available from empty classrooms, with appropriate rewiring and security measures added.

ii) Some districts prefer to have the computers available in each classroom, particularly at the elementary level. In this situation, the computers are usually kept on desks designed to be easily moved.

iii) Some schools have integrated the computers into the school library or existing media centre.

iv) Several districts which are planning the development of new school buildings have modified the architectural designs to include computer laboratories.

18. Changes are evident in most districts in the amount and type of communications, both in-house and to parents and the public, that have occurred as a result of the new technology.

i) Most districts report a definite improvement in the information delivery system to their governing boards, both in quantity and quality of information.

ii) Some districts report that members of their governing board show a greater selectivity and sophistication in the information requested.

iii) Better information is available to the public in several districts as a result of using cable television and word processing equipment.

iv) In several districts, administrators use closed-circuit television and radio to communicate with staff in local schools.

v) In several districts, technology is used to communicate with parents in a more timely and accurate way than ever before. Districts report using the computer to notify parents regarding school assignments, immunisations, absences on a daily and per class basis, report cards, grades, and test results. One district cautions against sending too much or too complicated information to parents, simply because the information is now so easily available.

Chapter II

Upper Secondary Education

A. Changes in Curricula

19. The impact of technology on upper secondary curricula is most evident in the addition of computer science courses and other computer-related courses in mathematics, science, and vocational education (e.g., job training courses).

-- The survey conducted by the US Council of Great City Schools indicates that all the large districts but one offer computer science courses, averaging about seven different such courses per district. In general, these course offerings focus on programming skills or computer theory.

-- One of the New Zealand case studies describes a secondary school which has implemented computer studies courses as an optional subject over a three-year sequence. A variety of topics are included, which are presented at more advanced levels of understanding each successive year.

-- One of the Dutch case studies describes a school for general secondary education in which computers are used for a computer science course, a test service system, and remedial teaching.

-- The Belgian study describes the use of computers in three secondary technical schools for teaching vocational training in the areas of accountancy and bookkeeping.

-- The vast majority of the districts described in the United States study have added new computer-related courses at the secondary level. Many districts reported [illegible] greater impact on the secondary curricula than on the elementary level.

-- In the United Kingdom case study of secondary education, computing studies courses are offered in which students learn at least three different computer languages and work in close contact with local businesses on real projects. In addition, a special course on Microcomputer Applications is offered.

20. The impact of technology at the secondary level is most evident in the addition of new courses, less evident in the modification of existing courses, and minimally evident in terms of interdisciplinary involvement.

-- The United States study indicates that the only modification of existing courses has occurred in the areas of mathematics, science, and vocational education. Other subject areas are relatively untouched by the new information technologies.

-- An exception is reported in a New Zealand case study in which the introduction of microcomputers has caused an increased awareness among the staff and students about some of the social implications of the new technology. As a result, a 12-hour module on "computer awareness" has been added to the Social Studies curriculum.

-- Another notable exception is described in the United Kingdom case study on secondary education. Computer awareness has been introduced as an essential element in each of the major subject areas of the core curriculum (mathematics, science, European studies/English, and humanities). In addition, the use of information technology has been gradually developed in science for simulation and data capture, in technology for design and drafting, in music for practice and self-correction in the learning of chords and intervals, in English for the development of linguistics and logical problem-solving, and in remedial courses for children with learning difficulties.

-- The United Kingdom secondary case study, the US Congress Office of Technology Assessment Report, and New Zealand's Case Study No. 2 cite the lack of high quality and appropriate software. In the United Kingdom study, teachers developed about 25 per cent of the software they use.

-- The vocational training programme described in the Belgian study implies some interdisciplinary involvement in that other subjects such as business law, economics, and management have been integrated with the use of technology.

B. Changes in the Teaching/Learning Environment

21. Little, if any, individualisation of instruction has been promoted by the use of technology at the secondary level.

-- The Belgian case study does report an increase in individualisation in that each group of three students creates a simulated business enterprise related to those students' progress. It is unclear, however, how the use of technology enhances this, since similar activities could be conducted on paper.

-- One of the Dutch case studies did not witness any increase in the degree of individualisation of instruction. However, student performance improved as a result of more structure and therefore more careful work.

-- A New Zealand case study points out the need for good quality and inexpensive software to meet the individualistic needs of students in order for them to work at their own level of ability, whether they be gifted or slow learners.

22. Teachers in the computer-related subject areas have learned new skills and modified their curriculum methodology accordingly.

-- Some of the districts in the United States study indicate that the teachers are forced to learn the new skills when they are mandated to teach new courses.

-- The Belgian case study indicates a use of new curriculum methodology by the teachers.

23. As with the primary level, it is difficult to estimate the numbers of secondary students and teachers who are involved with the use of computers.

-- As reported by the US Council of the Great City Schools, the ratio of students to computers is vastly improved over the primary level, with one computer available for every 186 secondary (grades 7 to 12) students.

-- In the United Kingdom every secondary school has at least two microcomputers.

-- In Denmark every secondary school has at least eight microcomputers with a ratio of one computer for every 40 students.

-- The districts in the United States study generally could not estimate the numbers of students enrolled in the various computer science courses.

24. The impact of the new information technologies on the attitudes of secondary teachers, students, and their parents is generally favourable.

-- The attitudes of staff in a New Zealand case study toward the introduction of computers are reported as highly positive.

-- The majority of teachers in the United States study who participated in some computer-related training are described as having changed from a skeptical to a less fearful and more enthusiastic point of view.

-- The students, teachers, and parents in the Belgian case study all seem to appreciate the applied nature of the coursework.

-- In the New Zealand case study, the impact of the microcomputers on the students' attitudes are reported as very individualistic, although generally favourable. Some instances are cited of students who lost interest in the computers presumably because of lack of time and facilities, as well as lack of appropriate software for their needs, while others became obsessed with the Computer Studies to the exclusion of all other subjects.

-- Support from the parents in the New Zealand case study is evident in that funds were made available from the PTA (Parent-teacher Association) for the purchase of computer hardware for the school.

C. Changes in Institutional Structures

25. The changes reported under this section in Chapter I also apply to secondary education.

Chapter III

Higher and Further Education

A. Changes in Curricula

26. Colleges and universities vary greatly in the extent to which new information technologies have effected changes in the curricula. However, all of the institutions of higher education included in the various case studies report some change. Information technology subjects such as control technology already feature in the curriculum particularly in technical and vocational education. These may be accompanied by a reappraisal of the relationship between content and process as it relates to the need of providing young people with the necessary skills to cope with rapid social and technological change. In this context the introduction of information technology can be seen to be part of a more general debate about the purpose of education and the balance between the needs of the individual and those of society.

27. Changes are likely to take place in the existing patterns of organisation in education in order to realise the full potential of information technology. In some cases this may demand the creation of new structures. This may happen relatively easily in the vocational and training sectors where outcomes are more readily measured. Here the introduction of information technology may demonstrate cost advantages and/or allow training to take place in more flexible circumstances.

-- At the low end in the United States study, computer awareness or literacy courses are an available option to all students, and application courses have been added in the departments of mathematics, science, and business.

-- At the high end in the United States study, all departments in the institution have integrated the use of technology into their degree programmes.

-- The extent to which new information technologies have caused change in the United States higher education curricula is largely a function of the overall focus

of the institution: the more technical schools indicate higher impact than do liberal arts schools.

-- Differences in the amount of curricular change are also attributable to the fact that the United States technology instructional programmes surveyed are in various stages of development -- some in the first one or two years of implementing the use of technology for instruction while others have been abreast of technological progress for 15 years.

-- In a New Zealand case study, faculty reports structural and/or content changes as a result of NITs in just over half of the 66 courses surveyed.

-- In the United Kingdom study of further education, new techniques and systems have had an effect on the content throughout the range of courses offered. This is largely attributable to the fact that training in the use of technology is the "raison d'être" for the college surveyed. Throughout every area of the college there is a concern for real applications as well as theoretical understanding.

28. Training of pre-service teachers is an area of moderate impact in terms of curricular changes in higher education as a result of NITs.

-- Generally, United States teacher education courses utilise hardware and software that is representative of what is currently used in elementary and secondary schools. This is usually integrated into standard "methods" courses.

-- Several United States institutions offer new degrees that focus specifically on the application of technology to education, for example, a Master's degree in Instructional Technology.

-- Overall, the structure, content, and methodology of the United States education pre-service training courses have not been impacted to a substantial degree. The US Congress Office of Technology Assessment reports that teacher training colleges in the United States are providing adequate instruction to new teachers in the use of information technology.

29. Technology-related training of in-service teachers is largely being conducted by the school districts that employ them.

-- Most United States districts have an ongoing professional growth programme for their teachers, to which new courses related to technology have been added. These programmes typically are optional, are scheduled after school hours, and offer in-service credit to the

teachers toward increased tenure or pay scale level. In some districts, this represents the entire teacher training programme in the technology effort; in other districts, this format is provided in addition to some more centrally-administered programme. The districts with this option report heavy teacher participation and interest for technology-related courses.

-- Several United States districts are mandating all teachers to participate in a centrally-administered training programme. In some cases, this learning is conducted during one school year. In other cases, the training is phased in over several years, usually starting with the teachers who will teach with computers first.

-- Some United States districts are providing training only for selected personnel, who are then expected to conduct training and/or act as a resource person at their local school. This responsibility is usually added to the staff person's regular duties (as teacher, librarian, assistant principal) with no additional salary.

-- A few United States districts have a decentralised training system, in which each school develops and implements its own training programme in line with the needs of the individual school. In some of these cases, the district will not approve a school's request to purchase computer equipment until adequate provision has been made for teacher training at that school.

-- The content covered in the United States training programmes ranges from programming and word processing skills to information about hardware, software, technical vocabulary, implementation strategies, operations, and classroom applications. Only a few districts focus on the broader aspects of technology and society, the future of technology, or the interdisciplinary integration of technology into the curriculum.

B. Changes in the Teaching/Learning Environment

30. Although the individualisation of instruction has not been significantly affected by the new information technologies in higher education, some notable exceptions do exist.

-- In two of the United States institutions of higher education, the students are able to work at their own pace in completing various course objectives on the microcomputer. In one of these universities, microcomputers are located throughout the dormitories,

giving the students a great deal of flexibility in completing course assignments.

-- In the United Kingdom case study of further education, the college operates on a philosophy to insure that every student makes use of the new technology in ways that are relevant to his or her studies and will be transferable to future changes in the workplace.

31. Little has been reported on the effects of NITs on student achievement, reflecting a lack of evaluation of new programmes. One case study did address this issue.

-- In a New Zealand case study, about half of the faculty respondents commented on various effects of NIT on student achievement. The majority felt that NITs have a positive effect on student grades, with increased student understanding, reinforcement of concepts and interest and awareness. However, several also cited some negative aspects of NIT on student achievement, such as failure by those with little previous computer experience or the tendency to not take systematic notes because of the new environment of the computer. Such examples imply poor teaching methods rather than negative effects of the computer per se.

32. The general attitude of those in higher education toward the new information technology ranges from very positive to a more "wait and watch" stance.

-- In a New Zealand case study, most of the faculty respondents indicated staff satisfaction in terms of enthusiasm and motivation in participating in the development of new innovations. However, some of the respondents cited frustration in terms of lack of technical back-up support and access to equipment, as well as excessive amounts of time needed for preparation and providing extra assistance to students.

-- The United Kingdom study of further education states that in order for lecturers to change their attitudes towards teaching and learning, they must first recognise that a problem exists in their using traditional methods. The College is attempting to influence the attitude of staff through the use of NIT for administration and management.

-- The faculty in the United States higher education case studies range in attitude from full commitment to the NIT to healthy skepticism. Those in the former category believe that faculty and students must have the ability to interact with the machinery of the information age, while those in the latter category believe that the role that computers can play in instruction is highly overrated.

-- A New Zealand case study reports student attitudes ranging from increased interest, motivation, and enthusiasm to some resistance, fear, caution, and apathy. The majority were in the positive category.

C. Changes in Institutional Structures

33. A definite increase in financial allocations for NIT is noticeable in all the case studies of higher and further education.

-- The bulk of financial resources has been earmarked for hardware.

-- Several campuses have altered or plan to alter physical facilities to accommodate the increase in NITs.

-- Funds tend to be more available for course proposals that have a technological focus.

34. Institutions of higher education have added new courses within departments. new departments, and new degree programmes with a technological focus.

35. Although some of the colleges and universities report the centralisation of new purchase, planning, and decision-making regarding NITs, the majority allow individual departments and/or faculty members to develop their own plans.

-- A New Zealand case study points out that university departments and faculties have always cherished their autonomy. Unfortunately, this situation also tends to result in a measure of unnecessary duplication.

Chapter IV

Distance Education

A. Changes in Curricula

36. The impact of distance education appears to be greatest in the area of higher and further education, and much less at the primary and secondary levels of education.

-- The United States study reports that several school districts utilise instructional television, cable television, closed circuit television, and/or radio to supplement the regular programme of primary and secondary instruction. However, except in a few rare cases, these distance strategies are not extensively used for instructional purposes.

-- The US Council of the Great City Schools reports that the majority of city schools now have, or plan to have, cable capacity. In addition, about half of these districts use electronic mail, several have or expect to have video-disc, and a few are experimenting with robotics. Some districts operate their own television or radio stations. Again, these distance strategies are in initial stages of implementation for instruction.

-- For several years some city colleges in the United States have offered degree programmes through local television stations, with examinations taken at one central location. Often such programmes are targeted at people who work full-time, are restricted by handicaps, or are isolated in settings such as prisons. These programmes are not documented in the case studies, but are generally known. They typically consist of videotapes of on-campus lectures, with no capability of interaction between student and teacher.

-- A case study from Turkey reports the use of a video system for in-service training of teachers of hearing impaired children.

-- A case study from an Australian university reports several uses of distance education: (1) on-line access to the library catalogue; (2) regular communication links for electronic mail, electronic course material, data files, assignments, and assessments; (3) teleconferencing by telephone to allow group discussions among staff and students; (4) teleconferencing via satellite between staff and distance students; and (5) special support services with modified tape recorders for disabled people.

-- A case study from British Columbia reports on distance education through the use of telecommunications networks as a joint venture of government, universities, community colleges, and provincial institutes.

37. Although institutions involved in distance education initially expected no changes in the curricula as a result of the NITs, changes have in fact been noted.

-- The Australian university case study describes initial efforts to use the same teaching staff, the same syllabus, and the same examinations for the on- and off-campus students. More recently, the validity of this model is being questioned given the technological changes that have occurred.

They see the integrated model as making a virtue out of necessity as well as having inherent educational merit. It is becoming increasingly clear that the integrated model supports a fragmented system of distance education in which there are too many providers.

-- The British Columbia case study indicates that despite expectations to the contrary, certain changes do take place when courses are taken from the classroom setting and adapted for distance delivery. The content itself remains relatively unchanged, but the distance education product is improved, being better planned, organised, structured, and presented than the average lesson delivered to a regular classroom. Distance education courses also tend to be more varied and stimulating, because a multi-media approach is chosen. over the traditional "chalk and talk" in the classroom. On the other hand, the distance education product is also less spontaneous, relaxed, and informal than the traditional classroom presentation.

-- The British Columbia case study speculates that the distance education medium must inherently require cognitive shifts in the information-processing skills used by the distance students, but that such changes are invisible, intangible, and difficult to articulate.

-- The Turkish case study reports that the curriculum became more flexible and changeable with the advent of video-aided teaching.

B. Changes in the Teaching/Learning Environment

38. Because the distance education student is isolated in the learning environment, a degree of individualisation of learning is inherent in this setting.

-- The British Columbia case study points out that distance education creates an environment of student-controlled learning. This has both liberating and intimidating aspects.

-- The Australian university case study indicates it is now more possible to individualise distance programs than produce standardized products. Students can work at their own pace under a computer-managed instructional system and can have access to a wide variety of information.

-- The Turkish case study reports no individualised instruction, in that only one video machine and program were available.

39. The lack of human interaction in distance education is a major change in the teaching/learning environment. However, various new strides in technology are increasing the possibilities of some interaction in distance education.

-- The Australian university case study describes the use of teletutorials (teleconferencing by telephone) that allow group discussions and teleconferencing via satellite that provide interaction between staff and students.

-- The British Columbia case study documents similar advances that will help to compensate for the "missing link" in distance education.

40. The attitude of those involved in distance education varies with the situation.

-- The video system-aided instruction described in the Turkish case study has motivated the teachers and helped them transfer their learning from one curriculum area to another. Furthermore, the success of this in-service training programme has spread and created interest in teachers from other schools for the deaf. The parents have also become interested, and some attend similar training once a year.

-- The British Columbia case study indicates individual differences in the views of the learners. Some would prefer on-campus access to people and resources and less distraction at home. Others preferred the comfort and convenience of the distance setting away from the anxiety-laden classroom. A frequent comment by the distance education students was that they worked very hard for the course credit and that the courses were academically rigorous.

-- Instructors in the British Columbia case study reported excessive amounts of time in the preparation of distance education materials, but also satisfaction in the quality of the products.

C. Changes in Institutional Structures

41. The area of distance education is so new that no real changes in institutional structures have yet been documented to any significant level. However, certain cautions and suggestions should be noted in anticipation of rapid growth in this area.

i) Admissions policies should become more flexible with regard to distance education students. The typical student may lack certain academic qualifications, but usually compensates by increased interest and motivation.

ii) Distance education can meet the needs of those people who could profit the most from further education but who cannot afford to pay the educational fees usually charged for higher education. Special education services should be provided for such groups of people (e.g., new immigrants, the unemployed, the handicapped) through government and/or private sector subsidies.

iii) Competition among universities is keen, and universities are now faced with competition from the private sector. It is important that the cost-effectiveness of delivery systems be continuously addressed, and that learning systems be developed that are not wasteful of money or resources. Distance education programmes have higher development and lower delivery costs over time than on-campus courses. Institutions with similar goals should form co-operative networking units to keep costs low and avoid duplication of effort.

iv) Often educational establishments tend towards self-conservation and are often slow to adapt and respond to a changing environment. There is evidence of resistance to change which is due to feelings of job insecurity. This is found in the case studies.

CONCLUSION: TRENDS AND ISSUES

42. These case studies indicate that the impact of the new information technologies on education is at an initial stage. The general trend in the case studies is that the introduction of new technologies has implications for the contents of what is taught and for the psychological mechanisms in the teaching/learning environment. It is obvious that the new technologies often modify existing subject areas, they offer new ways of structuring and, indirectly they teach pupils and students new ways of thinking. Changes are occurring so rapidly that the state-of-the-art at the commencement of this study is not the same as that at the conclusion of it. However, some broad trends and issues do emerge.

43. Microcomputers have had a greater impact on the curricula of secondary education than on that of primary or higher education. The primary curriculum is more broadly based and therefore more difficult to alter, while higher education is more fragmented and decentralised and thereby more impervious to change.

44. Distance education is utilised most for higher and further education.

45. Students have to "learn to learn" and to learn to gain access to knowledge. But as learning is a social phenomenon and as people need contact with other people in order to learn some subjects, the need for a human interface has not diminished. Humans will continue to help each other to learn. But for education this will involve a change of thinking about education and the role of teachers. Change of thinking is the first challenge for the human interface. The new learning systems require self-learning and responsibility, and the role of the human interface is now more crucial than ever before. As more and more information is available in the home, as more people can be served without the need for attendance, the locus of learning will change in importance.

46. The control of the educational task is increasingly delivered into the hands of the student. The learning becomes student-controlled rather than teacher-controlled. This can have a liberating effect on the learner, offering a degree of freedom and power never before experienced in the educational

system, but it can also be intimidating, as one is thrown back on one's own resources.

47. The sources of financial support for computers and instructional programmes reflect ingenuity and special interest groups rather than any firm commitment to optimum utilisation. In too many cases, the large-scale purchase of hardware seems to have preceded any comprehensive planning of how to use it. Pressure from parents, community groups, and computer vendors may be having a larger influence on the purchase of equipment than actual needs of the students and teachers.

48. Lack of high quality and appropriate software is cited frequently as a stumbling block toward effective use of technology. The greatest satisfaction for courseware is found in districts/schools that have developed their own to match local needs and curriculum objectives. This, however, is costly and time-consuming. Nevertheless, considering the large amounts of expenditures for hardware, a redirection of financial allocations toward software development might be more cost-effective in the long run.

49. Training of teachers is being undertaken much more in-depth by school districts than by teacher education institutions. This may cause a problem in the future when school districts have completed training of all in-service teachers and assume that new teachers have received appropriate pre-service training.

50. Very little evaluation of the impact of NITs on the quality of instruction or student achievement has been conducted. Attention should be directed toward this aspect before any increase in funds toward programme development. Evaluation should focus on components of technology-related instruction that appear to be effective as well as those that appear to be unnecessary or detrimental to learning. Mechanisms for the dissemination of such information are vital.

51. Computer-related courses for both students and teachers lack attention to the societal implications of the NIT. Courses should include discussions of the human, ethical, political, and economic implications of the new information age.

52. The new information technologies have the potential to be the "great equalizer", reaching all levels of the population and individualising instruction appropriately. However, these case studies indicate we are very, very far from such a state. The ratio of computers to students is huge, and at present, special populations of students (e.g., gifted, disadvantaged) have the greatest access. Furthermore, the lack of good software limits the extent to which individualisation of instruction can actually occur.

53. While new technology-related courses are being added to the curriculum at nearly all levels, little is being done to modify the existing curriculum. Since there is just so much

time in the school day, attention should be given to reviewing the overall curriculum for obsolete, unnecessary, or irrelevant material that may be dropped and/or changed. At the same time, mechanisms for the development of more interdisciplinary courses should be developed.

54. At the present time, software tends to be directed at lower-level cognitive skills, such as drill and practice, enrichment, and remediation. Until computers address the development of higher-order reasoning skills and problem-solving, their effect will naturally be limited.

55. Production of original programs is expensive, and it is often more economical to purchase existing products. But there is a danger of losing natural experience if too many imported programs are used. That is a key question in this area as a whole: Do we import culture, when we import software?

56. The new information technologies do stimulate a great deal of interest and motivation, particularly at the elementary and secondary levels. Faculty in higher education appear somewhat more reserved than faculty at the lower levels, although students indicate strong interest at all levels.

57. Some educational commentators are questioning the degree to which the NITs will impact education, pointing to the investments made in closed circuit television and in programmed instruction in the 60s and 70s, and their failure to meet expectations. They suggest that the microcomputer may be just another "fad" or trend, which will lose its glamour in time. This view underestimates two important characteristics of the NIT. One is the pervasive influence of information technology throughout social and economic life and the resulting consequences for the relevancy of the content of the existing curriculum. The second is the interactive capability of the NIT, which previous audio-visual technology in schools has lacked.

58. The case studies demonstrate the major changes beginning to take place in the content and process of the curricula due to the introduction of information technology. It may result in the study of information technology as a subject in its own right, as an extension of existing computer studies work, or as a cross curricula activity. It influences the content of the syllabus for a specific subject to take account of changes induced by the application of information technology in that subject area -- the study of robotics in craft and technology courses is a case in point. The technology may influence the way in which a subject is taught. The use of information retrieval packages to handle census material encourages a different approach to historical analysis. This in turn emphasizes the need to introduce information handling and problem solving skills and to recognise their importance alongside basic numeracy and literacy. There is beginning to be a reappraisal of methodology, in particular the opportunities for individualised and independent forms of study.

59. Case study respondents disagree as to the future role of information technology in education. Some view the computer as just another learning tool, one that will be important for instruction insofar as it facilitates teaching and learning. Perhaps the most exciting possibility that information technology holds for education is in making available more flexible opportunities for learning best suited to the individual's needs and circumstances. The new information technology will be able to help potential students find out what opportunities are available; provide new ways of delivering learning materials and in formats that allow much greater interactivity between the student and those materials; provide new ways of communication between the student and tutor and other students; make possible new techniques for helping students and teachers monitor progress. These opportunities are all based upon the use of information technology that will be found increasingly in the home. The information technology will support a shift of power away from the teacher towards the learner and make possible a considerable improvement in the quality of educational provision and opportunity. Others believe that the use of the computer can make true individualisation of instruction a reality. And others believe that educators must now rethink the role of the teacher within a new structure of the classroom, one which fully incorporates the computer into instruction while the teacher guides and manages more than teaches. In any case, until software address the development of higher-order thinking and reasoning skills as well as the interactive nature of learning, the computer will remain just another learning tool and the teacher will remain the provider of instruction.

60. As new devices enter to change the learning environment, such as computer, television and teleconferencing, so the interface between teacher and student is changed. If technological changes take place more quickly than changes in our ability to understand them, this problem will need to be addressed more fully if educators are to keep pace with our present age of rapid technological expansion. The effect of well-applied technology will be to improve instruction, but the effect of improved instruction is almost always to put greater demands on the creative teacher.